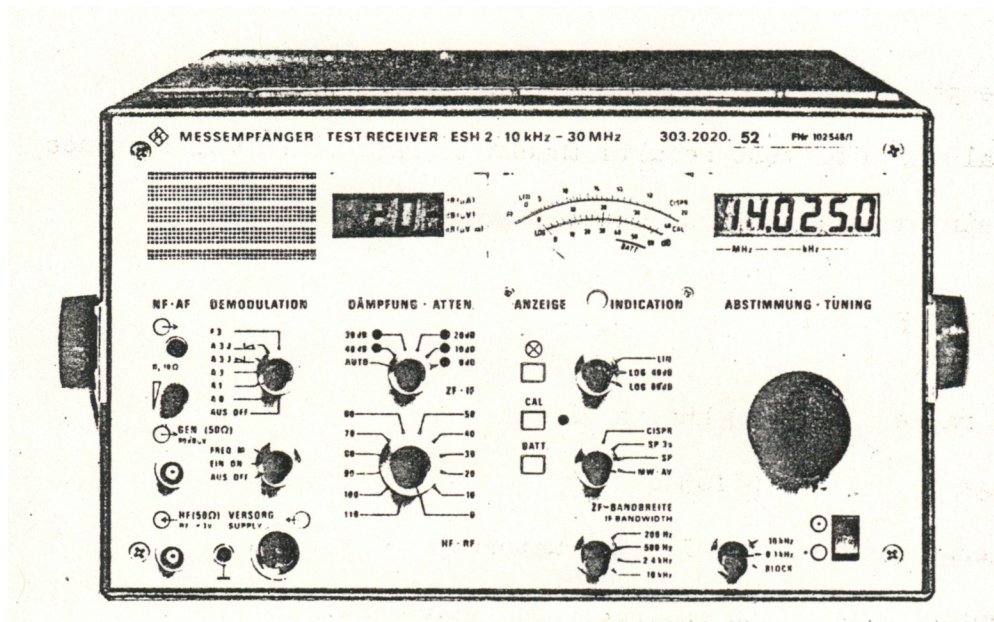




# TEST RECEIVER

10 kHz to 30 MHz



## Special Features

- High measuring accuracy
- Wide dynamic range
- Continuous frequency tuning without range switching
- Crystal-referenced frequency display
- Rapid automatic voltage calibration
- Automatic overload indication
- Two-port measurements with tracking generator
- Remote frequency measurement
- Interference measurements according to CISPR, VDE, MIL and VG
- AC supply and battery operation
- Compact design

## P R E C I S E

Digital frequency display with 100-Hz resolution

Frequency synthesis for all oscillators

Single button triggers sinewave/pulse calibration sequence  
for high measuring accuracy

Excellent dynamic characteristics

## E C O N O M I C A L

Attractive price

Simple evaluation of test results thanks to integrated intelligence

Short measuring times thanks to user convenience features

## G E N E R A L - P U R P O S E

Frequency range            10 kHz to 30 MHz

Level range                > 165 dB

Separate control of RF and IF attenuators

Measurement of signal and interference field-strength,  
voltage and current

Two-port measurement: gain 50 dB, attenuation 100 dB

Versatile demodulation capabilities

## E A S Y   T O   O P E R A T E

Digital frequency display

Digital display of scale reference level

Automatic control (can be switched off) of IF attenuator

Rapid frequency selection thanks to switch-selected tuning speed

Clear front panel layout

## Characteristics and Uses

The Test Receiver ESH 2 is a versatile, highly selective receiver covering the frequency range from 10 kHz to 30 MHz. Appropriate accessory equipment extends the application area of the ESH 2 to include field-strength measurements (HFH 2) and interference measurements.

Compact design, light weight (approximately 20 kg) and the wide range of power supplies which can be used (internal +12-V supply, external +12-V or +24-V supply or mains power supply unit for the usual AC voltages) make the receiver suitable for stationary as well as mobile and portable use.

Without requiring any accessory equipment, the ESH 2 can be used as a selective voltmeter with a measurement range of  $-30 \text{ dB}(\mu\text{V})$  to  $+137 \text{ dB}(\mu\text{V})$  for  $50\text{-}\Omega$  systems in the laboratory and test department. Relative and absolute selective voltage measurements are possible even in the presence of a multitude of signals. Internal automatic calibration and excellent receiver selectivity resulting from the use of IF filters of high skirt selectivity and low-sideband-noise oscillators throughout the receiver permits low-level signals close to high-level signals to be measured with high accuracy; e.g. SSB two-tone measurements, spurious content or sideband noise measurements on signal generators, intermodulation measurements, distortion measurements, noise figure measurements, etc.

Evaluation of the signals is made easier by the four switch-selected IF bandwidths and a great number of test outputs, such as a broadband IF output of 75 MHz for connection of a panoramic display unit or a wave analyzer; a narrow-band IF output of 30 kHz for connection of an oscilloscope; AM and FM demodulator output; recorder outputs for level and frequency offset; output for two-port measurements, etc.

Thanks to the available A1, A3, A3J and FM demodulation capabilities and frequency setting of high accuracy and stability, the receiver - in conjunction with a receiving antenna and a precision frequency counter - can be used to advantage for radiomonitoring purposes where information content, frequency, time and duration of an emission are essential. In conjunction with a frequency counter, exact remote frequency measurements can be made, the ESH 2 being used as a selective active filter.

Adding the active Rod Antenna HFH2-Z1 (10 kHz to 30 MHz), the active Loop Antenna HFH2-Z2 (10 kHz to 30 MHz) and the Inductive Probe HFH2-Z4 to the ESH2 forms the Field-strength Meter HFH 2. An additional Loop Antenna HFH2-Z3 (10 kHz to 150 kHz) is available for extremely sensitive measurements in the low frequency range. Use of the HFH 2 in conjunction with a YT recorder permits antenna measurements, measurement of the propagation conditions and transmitter coverage for radiomonitoring purposes.

An Active Probe (ESH2-Z2), a Passive Probe (ESH2-Z3), a Clamp-on RF Current Probe (ESH2-Z1) as well as an Artificial Mains Network (ESH2-Z5) can be supplied for interference measurements (current and voltage) in line with the relevant regulations (MIL, CISPR, VDE, VG).

When measuring field strength with these antennas, the scale reference level is directly read out on an LCD display in dB( $\mu$ V/m), the antenna factor of the antenna involved being taken into consideration. The error of the field-strength measurement is < 2 dB which satisfies the requirements laid down in the CCIR recommendations.

When using other sensors, such as a clamp-on RF current probe and an inductive probe, the conversion factor is likewise taken into consideration. The measured value is then indicated in dB( $\mu$ A) and dB( $\mu$ V/m), respectively.

This and a large number of other logic functions together with a clear front panel layout and internal automatic calibration enable unskilled personnel to operate the receiver error-free after a very short training period and arrive at correct test results:

Automatic IF gain control as a function of the IF bandwidth and type of indication selected, for an inherent noise indication of the receiver of < 0 dB.

Overload is indicated by a blinking scale reference readout as soon as one of the stages in the indicator section of the receiver is overdriven. Overload indication is obtained from interfering sinewave signals as well as from interfering pulses.

Internal calibration activated at the push of a button or automatically when the bandwidth is changed constitutes a complex self-test of the receiver which covers all the circuits and compares the actual gain of the receiver with the nominal value. Moreover, the state of charge of the batteries can be checked on the level meter at the push of a button in the case of battery operation.

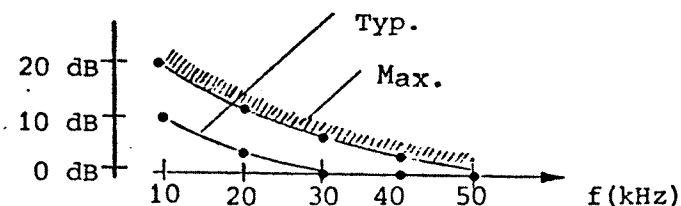
Although its weight has been minimized, the Test Receiver, designed using the R&S compact casing system, fulfills all requirements of stationary and mobile use.

## Specifications

### Test Receiver ESH 2

Frequency range	10 kHz to 29.9999 MHz
Frequency readout	6-digit LCD display; switchable back-lighting
Frequency resolution	100 Hz
Setting error	
Range 10 kHz to 150 kHz	100 Hz
Range 150 kHz to 30 MHz	< 500 Hz
Internal noise ( $f_{in} > 50$ kHz):	
Average value (IF bandwidth 200 Hz, linear)	typ. -30 dB( $\mu$ V)
Peak value (IF bandwidth 200 Hz, linear)	typ. -22 dB( $\mu$ V)
CISPR 1 (IF bandwidth 9 kHz, linear)	typ. -6 dB( $\mu$ V)
CISPR 3 (IF bandwidth 200 Hz, linear)	typ. -28 dB( $\mu$ V)

Increase in internal noise for  $f < 50$  kHz (with  $B_{IF} = 200$  Hz)



Voltage range:

Lower limit for 3 dB increase in indication: see noise indication

Upper limit:

RF attenuation = 0 dB, signal(s)  
within range of RF filters  
RF attenuation  $\geq 10$  dB

130 dB( $\mu$ V)

137 dB( $\mu$ V)

Inherent spurious responses

equivalent to < -6 dB( $\mu$ V)

Voltage indication

on moving-coil meter;  
switchable back-lighting

Indicating ranges

linear 20 dB  
log. 40 dB  
log. 60 dB  
battery voltage

Types of indication

average value  
peak value  
peak value with 3 s hold time  
CISPR (Publ. 1 and 3)

Voltage indication error:

(average-value indication, lin. 20 dB  
IF bandwidth 200 Hz,  
 $V_{in} > -10$  dB( $\mu$ V))

< 1 dB

Additional error of logarithmic  
conversion due to temperature effect < 2 dB

Calibration generator:

Average/peak value                      sinewave generator  
CISPR (Publ. 1 and 3)                   pulse generator

IF bandwidths (for average value and peak value):

	3-dB bandwidth		6-dB bandwidth		Ratio 6 dB:60 dB
200 Hz <sup>+) )</sup>	160 Hz	+10%	200 Hz	+10%	≈ 1:5
500 Hz	550 Hz	+20%	630 Hz	+10%	≈ 1:5
2.4 kHz	2.4 kHz	+10%	2.6 kHz	+10%	≈ 1:1.8
10 kHz	8 kHz	+10%	9.5 kHz	+10%	≈ 1:2.4

<sup>+) )</sup> Reduced accuracy when measuring sinewaves at 200 Hz bandwidth (additional measuring error 1.5 dB, max.) due to receiver tuning in steps of 100 Hz.

IF bandwidths (-6 dB)

for measurements according to CISPR  
Publ. 1 and 3 and according to VDE 0875

0.2 kHz/9 kHz  
(automatic switchover)

Types of modulation

FM, AØ, A1, A3, A3J (LSB, USB)

Image frequency rejection

> 100 dB, typ. 120 dB

IF rejection

> 100 dB, typ. 110 dB

RF input

BNC female connector

Input impedance

50 Ω

VSWR

at 0 dB RF attenuation

< 2

at ≥ 10 dB RF attenuation

< 1.2

Oscillator reradiation

< 0 dB(μV)

Internal input filters:

Range	1	band-pass filter	10 kHz to < 150 kHz
"	2	Sub-octave filter	150 kHz to < 200 kHz
"	3	"	200 kHz to < 280 kHz
"	4	"	280 kHz to < 390 kHz
"	5	"	390 kHz to < 540 kHz
"	6	"	540 kHz to < 750 kHz
"	7	"	750 kHz to < 1.05 MHz
"	8	"	1.05 MHz to < 1.45 MHz
"	9	"	1.45 MHz to < 2.0 MHz
"	10	"	2.0 MHz to < 2.7 MHz
"	11	"	2.7 MHz to < 3.7 MHz
"	12	"	3.7 MHz to < 5.2 MHz
"	13	"	5.2 MHz to < 7.2 MHz
"	14	"	7.2 MHz to < 10.0 MHz
"	15	Tracking filter	10.0 MHz to < 20.0 MHz
"	16	"	20.0 MHz to < 30.0 MHz

# Non-linearities

Frequency range 10 kHz to 150 kHz (frequency spacing for 2 signals:  $\geq 40$  kHz).

Type	Level	Level ratio of resulting inter- ference signal(s)	Intercept point (min.)	Intercept point (typ.)
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K2	100 dB( $\mu$ V)	> 55 dB	+30 dBm	+45 dBm
D2	100 dB( $\mu$ V)	> 50 dB	+25 dBm	+40 dBm
D3	90 dB( $\mu$ V)	> 65 dB	+15 dBm	+20 dBm

Frequency range 150 kHz to 30 MHz

K2	100 dB( $\mu$ V)	> 80 dB	+75 dBm	+100 dBm
D2	100 dB( $\mu$ V)	> 60 dB	+55 dBm	+75 dBm
D3	100 dB( $\mu$ V)	> 55 dB	+20 dBm	+25 dBm

## Crossmodulation:

An interference signal (30% modulation depth, modulation frequency 1 kHz) spaced > 100 kHz away produces 3% unwanted modulation of the wanted signal of 20 dB( $\mu$ V) at a level of > 100 dB( $\mu$ V)

RF leakage: At a field strength of 10 V/m and a frequency  $f \neq f_{in}$ , the indication may vary by < 1 dB

## Outputs

### Front panel

Generator output (can be switched off)	BNC female connector
Source impedance	50 $\Omega$
EMF	86 dB( $\mu$ V) $\pm$ 0.5 dB
Connector for antenna supply and antenna coding	12-pole Tuchel female connector
AF output	Jack JK 34
Source impedance	10 $\Omega$
EMF	adjustable up to 3.5 V

### Rear panel

75-MHz IF output	BNC female connector
Source impedance	50 $\Omega$
Gain (referred to input at 0 dB RF gain)	9 $\pm$ 3 dB (bandwidth corresponds to RF bandwidth)
30-kHz IF output	BNC female connector
Source impedance	1 k $\Omega$
EMF (at f.s.d.)	2 V (bandwidth corresponds to IF bandwidth)
AM demodulator output	BNC female connector
Source impedance	10 k $\Omega$
EMF	1 V/100% modulation depth
FM demodulator output	BNC female connector
Source impedance	10 k $\Omega$
EMF	$\pm$ 0.5 V for 5 kHz frequency deviation
External reference frequency input	BNC female connector
Required EMF	1 V at $Z_{out} = 50 \Omega$ , sine wave
Frequency	5/10 MHz (switch-selected)

Recorder outputs	50-way female connector (Amphenol)
Frequency offset output:	
Source impedance	10 k $\Omega$
EMF	$\pm 5$ V for $\pm 5$ kHz offset
Level output 1:	
Source impedance	10 k $\Omega$
EMF (with indicating modes (AV, PEAK, PEAK 3 s))	$\pm 5$ V for f.s.d. on panel meter
EMF (with indicating mode CISPR)	$\pm 2$ V for f.s.d. on panel meter
Level output 2:	includes a lowpass filter for simulation of panel-meter response according to CISPR (Publ. 1 and 3); source impedance and EMF, same as for level output 1
Supply voltage inputs:	
Battery input	4-way special female connector
Voltage	+10.8 to +14.5 V
Current consumption	approx. 1 A
Charging input	4-way special female connector
The Test Receiver ESH 2 is a safety class III unit according to VDE 0411 (DIN 47411).	
Current supply	either from built-in power supply or from built-in battery pack
Dimensions W x H x D	339 mm x 198 mm x 484 mm
Weight	approx. 19 kg with power supply fitted approx. 21 kg with battery pack fitted
Power supply:	
Design of power supply	The power supply has been designed in accordance with the recommenda- tions of VDE 0411 (DIN 47411), class II, and is provided with pro- tective insulation
AC supply voltages	110/125/220/235 V
Permissible AC supply voltage fluctuations	-15% to +10%
AC supply frequency	47 to 420 Hz
Power consumption	60 VA, max.
The power supply unit can also be used as a battery charger.	
Battery pack:	
Battery voltage	+12 V
Battery capacity	8.5 to 9.5 Ah
Operating life of a fully charged battery	approx. 4 hours (depending on ambient temperature)
General data:	
Rated temperature range	-10 to +45 $^{\circ}$ C
Storage temperature range	-25 to +70 $^{\circ}$ C (without batteries) -10 to +60 $^{\circ}$ C (with batteries)
Order designation:	
Test Receiver ESH 2	303.2020.52

# Accessories supplied:

Qty.	Designation	
1	Manual consisting of: operating manual servicing manual (2 volumes)	
1	Battery pack (without batteries)	303.3110.00
2	Fuses for battery pack: M 6,3 E DIN 41571	020.7623.00
2	Fuses for power supply (220/235 V): T 0,5 B DIN 41571	020.7352.00
2	Fuses for power supply (110/125 V): T 1 B DIN 41571	020.7446.00
2	Incandescent bulbs	234.4375.00
2	Incandescent bulbs	063.7702.00
1	Battery connector, male Make: LEMOSA, Type F.c 2304 6,7	303.9447.00
1	50-way male connector, Amphenol	018.5904.00

## Recommended extras for ESH 2:

Active antenna for measurement of electric field component: Rod Antenna HFH2-Z1	335.3215.52
Active antenna for measurement of magnetic field component in the range 10 kHz to 30 MHz with constant conversion factor: Loop Antenna HFH2-Z2	335.4711.52
Active antenna for measurement of magnetic field component in the range 10 kHz to 150 kHz (1 MHz) with constant conversion factor: Loop Antenna HFH2-Z3	335.6214.52
Tripod for loop antennas: Tripod HFU-Z (in carrying bag)	100.1114.02
Probe for measurement of magnetic field component in the range 100 kHz to 30 MHz: Inductive Probe HFH2-Z4	338.3016.52
Sensor for current measurement in the range 100 kHz to 30 MHz: Clamp-on RF Current Probe ESH2-Z1	338.3516.52
Probe with high input impedance for the range 10 kHz to 30 MHz: Active Probe ESH2-Z2	299.7210.52
Probe to VDE 0876 for measurements on lines in the frequency range of 10 kHz to 30 MHz: Passive Probe ESH2-Z3	299.7810.52
Artificial mains network to VDE 0876 for the frequency range 10 kHz to 150 kHz (30 MHz): Artificial Mains Network ESH2-Z5	338.5219.52

Adapter for battery operation of the ESH 2 from a +24-V supply: 24-V Adapter ESH2-Z4	338.4512.02
6-V storage batteries for battery operation of the ESH 2 (2 batteries required!): 6-V Lead-acid Storage Battery/ 9.5 Ah	338.4012.00
Suitable battery makes:	
Sonnenschein, 6470 Bldingen, West Germany, Type 3F x 5S	
Varta, 3000 Hanover, West Germany, Type accu-Pb 6 V, 9.5 Ah	
Elpower Corp., Santa Ana, Calif., USA, Type EP 685 A-16	
Adapter set for converting the ESH 2 to a 19" rackmount 19" Adapter ESH2-Z6	338.4312.02
Service kit for repair purposes (flexible adapter cable + set of coaxial cables so that boards can be operated outside of the receiver): Service Kit ESH2-Z7	338.4112.02
Protective cover for front and rear panels (2 recommended if instrument predominantly for portable use):	
Protective Cover	303.2065.00
YT recorder, e.g. R&S XYT Recorder ZSKT	301.9010.02
Attenuator 50 $\Omega$ , e.g. R&S DPU 0 to 140 dB	100.8960.55
Headphones, e.g. R&S	110.2959.00
External frequency standard f: 5 MHz or 10 MHz Error: $< 2 \times 10^{-6}$ Level: 1 V at 50 $\Omega$ , e.g. R&S XSD 2	283.6010.02
Frequency counter for remote frequency measurement Frequency range: 10 kHz to 30 MHz Sensitivity: $< 10$ mV into 50 $\Omega$ Accuracy: depending on requirement, e.g. Philips PM 6615	
Wave analyzer or panoramic display unit for broadband analysis Frequency range: 75 +1 MHz Noise figure: $< 20$ dB	
Oscilloscope for checks on the output signals Frequency range 0 to 100 kHz y sensitivity $< 5$ mV/cm, e.g. Tektronix Series 7000	
VSWR bridge for reflection-coefficient measurements Z = 50 $\Omega$ , frequency range 10 kHz to 30 MHz, e.g. WILTRON, Model 68B50 (50 kHz to 32 MHz); MCL, Model PDC-15-6 (10 kHz to 35 MHz)	